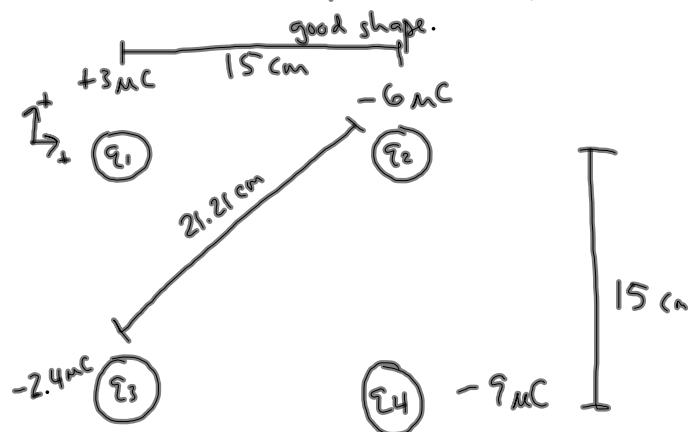


P. 568 #2:

* this is more difficult than you will have to do on a test, so if you can do this you are in

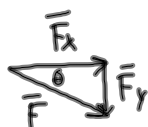
good shape.



a) find \vec{F} on $+3 \mu\text{C}$ charge

$$\begin{aligned}\sum \vec{F}_x &= \vec{F}_{21x} + \vec{F}_{41x} + \vec{F}_{31x} \\ &= \frac{k|q_2||q_1|}{r_{12}^2} + \frac{k|q_4||q_1|}{r_{14}^2} \cos(45^\circ) \\ &= \frac{(8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2)(6 \times 10^{-6} \text{ C})(3 \times 10^{-6} \text{ C})}{(.15 \text{ m})^2} + \frac{(8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2)(9 \times 10^{-6} \text{ C})(3 \times 10^{-6} \text{ C})}{(.2121 \text{ m})^2} \cos(45^\circ) \\ &= 11.01 \text{ N}\end{aligned}$$

$$\begin{aligned}\sum \vec{F}_y &= \vec{F}_{21y} + \vec{F}_{41y} + \vec{F}_{31y} \\ &= -\frac{k|q_2||q_1|}{r_{12}^2} - \frac{k|q_4||q_1|}{r_{14}^2} \sin(45^\circ) \\ &= -\frac{(8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2)(6 \times 10^{-6} \text{ C})(3 \times 10^{-6} \text{ C})}{(.15 \text{ m})^2} - \frac{(8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2)(9 \times 10^{-6} \text{ C})(3 \times 10^{-6} \text{ C})}{(.2121 \text{ m})^2} \sin(45^\circ) \\ &= -6.69 \text{ N}\end{aligned}$$

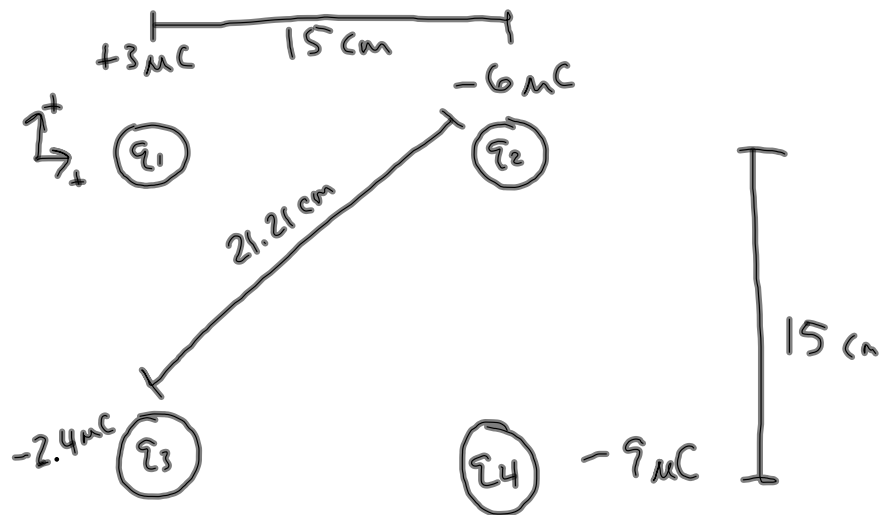


$F = 12.9 \text{ N}$ (from Pythagorean thm.)

$$\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right)$$

$$= 31.3^\circ$$

S of E



b) find \vec{F} on $-6 \mu\text{C}$ charge

$$\begin{aligned}\Sigma \vec{F}_x &= \vec{F}_{12x} + \vec{F}_{42x} + \vec{F}_{32x} \\ &= \frac{-k|q_1||q_2|}{r_{12}^2} + \frac{k|q_3||q_2| \cos(45^\circ)}{r_{23}^2} \\ &= \frac{-(3 \times 10^{-6} \text{C})(6 \times 10^{-6} \text{C})}{(.15 \text{ m})^2} + \frac{(2.4 \times 10^{-6} \text{C})(6 \times 10^{-6} \text{C}) \cos(45^\circ)}{(.2121 \text{ m})^2}\end{aligned}$$

$$= -5.151 \text{ N}$$

$$\begin{aligned}\Sigma \vec{F}_y &= \vec{F}_{12y} + \vec{F}_{42y} + \vec{F}_{32y} \\ &= \frac{+k|q_4||q_2|}{r_{24}^2} + \frac{k|q_3||q_2| \sin(45^\circ)}{r_{32}^2} \\ &= \frac{(9 \times 10^{-6} \text{C})(6 \times 10^{-6} \text{C})}{(.15 \text{ m})^2} + \frac{(2.4 \times 10^{-6} \text{C})(6 \times 10^{-6} \text{C}) \sin(45^\circ)}{(.2121 \text{ m})^2}\end{aligned}$$

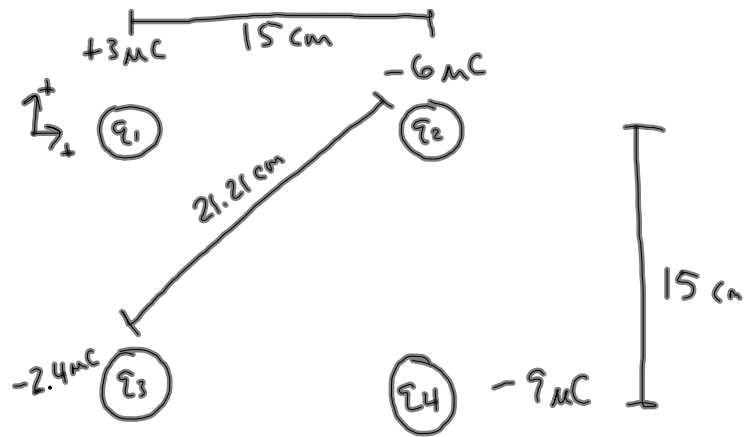
$$= 23.61 \text{ N}$$



$$F = 24.2 \text{ N}$$

$$\theta = 79^\circ$$

N of W



c) find \vec{F} on $-9 \mu\text{C}$ charge

$$\begin{aligned}\sum \vec{F}_x &= \vec{F}_{14x} + \vec{F}_{24x} + \vec{F}_{34x} \\ &= \frac{-k|q_1||q_4|}{r_{12}^2} + \frac{k|q_3||q_4|}{r_{34}^2} \\ &= \frac{-(1)(3 \times 10^{-6})(9 \times 10^{-6}) \cos(45^\circ)}{(.2121 \text{ m})^2} + \frac{(1)(2.4 \times 10^{-6})(9 \times 10^{-6})}{(.15 \text{ m})^2} \\ &= 4.815 \text{ N}\end{aligned}$$

$$\begin{aligned}\sum \vec{F}_y &= \vec{F}_{14y} + \vec{F}_{24y} + \vec{F}_{34y} \\ &= \frac{+k|q_1||q_4| \sin(45^\circ)}{r_{12}^2} - \frac{k|q_2||q_4|}{r_{24}^2} \\ &= \frac{(1)(3 \times 10^{-6})(9 \times 10^{-6}) \sin(45^\circ)}{(.2121 \text{ m})^2} - \frac{(1)(6 \times 10^{-6})(9 \times 10^{-6})}{(.15 \text{ m})^2} \\ &= -17.76 \text{ N}\end{aligned}$$

$$\begin{aligned}F &= 18.4 \text{ N} \\ \theta &= 74.8^\circ \\ \text{S of E}\end{aligned}$$